PRODUCTION OF ARROW HEAD PRODUCT BY USING CNC MACHINE

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ABSTRACT

In this research, the production of an Arrow Head product using CNC machine is being discussed thoroughly. This research reveals the turning and milling process of using CNC machine. This information is important to the readers in planning future step in fabricating similar type of product. The information is obtained through phone interview and internet. Thus, this paper precisely reveals the actual processes that involve in manufacturing of an arrow head product and discovers the function of utility of different types of CNC machines. Besides, it can widen readers view by studying more about the production of ARROW-LOK Hybrid.

Keywords
CNC machine, Turning process, Milling process, Arrow head, Production

1.0 INTRODUCTION

The Industrial Trend started around 1733 in Great Britain, many of the machine devices were introduced and develop in this industrial age. One of the best machine technological innovations is the computer numerical control (CNC) machine device. It is a numerical control (NC) machine that comes along with a computer. NC machines were first developed after World War II. It can help to reduce the production time and increase both the quality and efficiency of a product (A brief history of CNC, 2009). The product that we choose to study is Arrow-Lok Hybrid, which is a medical device utilized in the treatment of musculoskeletal conditions so it must in high accuracy of dimension. Therefore, a high precision of machine is needed. CNC machine definitely able to serve all the criteria needed in the production of Arrow Head Product.

1.1 OBJECTIVES

1. To reveals the turning process and milling process of CNC machine in the production of Arrow Head Product.
2. To provide significant reference to the readers in planning future step in fabricate similar type of product.
3. To provid detail info about the CNC machine and disclose the advantages of using the CNC machines.

2.0 LITERATURE REVIEW

CNC machine is a type of machine that uses digital information to control the movements of tools and parts, for example like the spinning speed, the cutting speed, controlling the rate of movement of the tool tip and etc. Thus the production procedure can be changed simply and quickly by just modifying the information or program in the computer (Rao, 2011). There are different types of CNC machines. Only two types of CNC machines will be discussed in this research which is CNC turning machine and CNC milling machine.

The CNC turning machine used is Tsugami BS19B. Tsugami BS19B is very flexible machine that can reproduce high accuracy parts with exact accuracy up to infinity times by programming the computer. It is designed to provide quick job changeover from part to part, allow for long uninterrupted production runs with no operator intervention, and can eliminate time consuming tool shimming and facilitates short runs (Mullen, 2009.). In the research, the CNC turning machine is used to produce the head of arrowhead, body and radius groove.

CNC milling machine is well-designed and good for one-off, as well as geometrically simple objects. Yet, a complex part of a material can be milled with high detail and accuracy too. Thus, it can be said that virtually any material can be milled with a proper cutter and at the same time lower the cost of the operation (Burt, 2003). In this research, CNC milling machine is used to sharpen the shape of both side of the arrowheads.

3.0 METHODOLOGY

The material used to produce the ARROW-LOK Hybrid (Figure 1) is ASTM F138 Stainless Steel Bar which are 3 meter long with diameter 4mm.

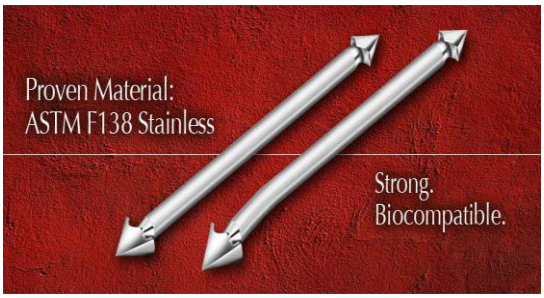

Figure 1: Arrow-lok hybrid

We conduct our research by:
1. First, we collect the description detail of product from the internet and the product's webpage. (http://arrowheaddevices.com/)
2. Next, we gain the detail information of manufacturing process of ARROW-LOK Hybrid through the phone interview with the supervisor of Arrowhead Medical Device Technologies, LLC.
3. In our study, we had disclose the picture for each stage of the development process of the ARROW-LOK Hybrid for the reader to review it.
4. The process flow chart and as well as the pros and cons of using CNC Machine that we gain from the web sources and interviewer had been combined and interpreted.

4.0 FINDINGS

4.1 CNC Turning Process

First, load the material onto the CNC turning machine. Then, produce the head of arrowhead by taper turning. After that, use the parting tool to make a notch for the purpose to produce the body of the product. Next, produce the radius groove that is located behind the head of arrowhead by grooving. Again, produce the tail of arrowhead by taper turning. Lastly, parting (cut off the semi-manufactured product and send for next process)

4.2 CNC Milling Machine

First, load the parts on a fixture (20 parts per fixture) and load the fixture onto the CNC milling machine. Then, cut off both side of the head of arrowhead. Make the head of arrowhead to the size that needed. Next, smoothen and flatten the head of arrowhead. After that, unload the fixture, turn over, and load again in order to process the tail of arrowhead. Again, mill the tail of arrow head to the size that need to be smoothen and flatten the tail of arrowhead.

5.0 DISCUSSION & CONCLUSION

5.1 Limitation

The CNC Turning machine that used to produce the ARROW-LOK Hybrid is Tsugami BS19B which is able to turn, mill and drill in order to produce high accuracy and high precision of work pieces. Even though the process of producing ARROW-LOK Hybrid comprises of two processes which are turning process and milling process, it is not suitable to use this Tsugami machine to complete the both processes. This is because the end part of ARROW-LOK Hybrid is in sharp shape. Thus, the guide bush of the machine cannot hold on the work piece and the work piece may drop before the whole production process is completed. Due to this circumstance, we're forced to use separated machines to produce the product so that it will have a sharp shape at the end of the product. Hence, this is one of the biggest limitation of using the CNC machine to produce the ARROW-LOK Hybrid.

5.2 Pros And Cons

Utilization of computers in manufacturing application has been proven to be one of the most significant advantages and developments over the last couple of decades in helping to increase the productivity and improve the efficiency of manufacturing systems. The advantages include CNC machines which can control precisely the tools movement in any axis and it usually have automatic changing tools function.
The advantage of using CNC machines is it can be used continuously 24 hours a day, 365 days a year and only need to be switched off for occasional maintenance. This show that CNC machine is a very powerful plus long-lasting machine and it is suitable to be use for continuous production. Furthermore, it helped to increase the productivity everyday because the authority can arrange more than 2 shifts of working schedule per day. Besides that, it is a semi-automated system due to the human intervention that still needed in the system but require none of any manual adjustment when operating the CNC machine. Therefore, the CNC machine can run at a high speed (P.N.Rao, 2011). In facts, the workload of worker has definitely reduced but the responsibility of a worker is increased. For example, each worker is required to handle more than one machine simultaneously. In such management, the number of labor can be reduced and indirectly reduced the labor cost.
On the other hand, there are some restrictions when using the CNC machines. The cost of purchasing a CNC machine is high. The expensive training and money are needed to be spent on employees and equipment. Hence, it may increase the fixed cost of the product and greatly reduce the profit.

5.3 SUGGESTION

Transfer time is very important in time study. Sometime the transfer time may significantly influence the lead time if transferring occur frequently. In such circumstance, the layout of machine can be rearranged to minimize the transfer time. For example, the milling machine can be set up beside the turning machine so that the process can be run continuously without any break off. In other words, it means that the transfer time is negligible. Besides that, a worker also can handle both machines simultaneously and such management will definitely help to reduce the labor cost.

Other than that, manufacturers are suggested to implement Jidoka system in order to detect the defective parts. Jidoka or autonomation can detect the defect of product automatically and it immediately stop the machine and alert the operator by generating sound or light. By applying the Jidoka system it will result in minimization of the production of wasted defects items and over productions. Figure 2 shows the evolution of Jidoka.

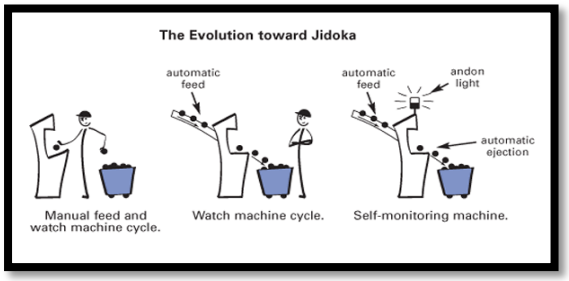

Figure 2: Jidoka system : *Source from*: http://www.lean.org/Common/LexiconTerm.aspx?termid=233&height=..

Last but not least, during the milling process, a electronic screwdriver can be used to load/unload the fixture from the machine and parts from the fixture. We believe that with the aid of this device surely will increase the efficiency of work and reduce the time taken for load and unload the fixture.

5.4 Conclusion

Computer numerical control (CNC) machines are very important no matter for the production in manufacturing industries or medical devices. We can't deny the effective function of the CNC machine in manufacturing system. For example, one of the most significant function of CNC machines is it helps to increase the productivity and improve the efficiency of manufacturing system. Here we are pleased to introduce more detail about the usefulness of a CNC machine in our project.

In this research, we choose to introduce ARROW-LOK Hybrid and explore more detail in our project. The reason we choose the ARROW-LOK Hybrid is because it is a brand new innovative product and it had fully utilized the CNC machine in the production process. In the production of ARROW-LOK Hybrid ,CNC turning machine and CNC Milling machines have been used to complete the process of building and shaping the arrowheads.

The study about the production process of ARROW-LOK Hybrid is very interesting to this study. From here we get to know about the concept of how ARROW-LOK Hybrid is being made and what process involves in its manufacturing. Apart from that, we are also exposed to the manufacturing concept wisely. For example, the concept of manual operation, automated system, semi-automated system, control system, sensing system, single station manufacturing cell, GT, FMS and etc.

For instance, the manufacturing of ARROW-LOK Hybrid involves the concept of semi-automated system, single station manufacturing cell and control system only. ARROW-LOK Hybrid classify in the category of production by using the semi-automated system since the worker is needed to load the material into the CNC machine for the production process. It is obvious to say that the production of ARROW-LOK Hybrid is using the control system because the CNC Turning machine and CNC Milling machine itself is a control system. CNC Turning and CNC Milling machines are located at different departments and independent of each other. They are considered as single-station manufacturing cell. Thus, the layout is not in a single flow line. The utilization of CNC Turning machine and CNC Milling machine in the production process of ARROW-LOK Hybrid had completely fulfill all the three manufacturing concept above and help us understand the concept well.

In the production of ARROW-LOK Hybrid, we can see that there are many steps and procedures that need to be followed in order to ensure that the production process is going smoothly. There are three main production of ARROW-LOK Hybrid which are CNC Turning process, CNC Milling process and Inspection process. ARROW-LOK Hybrid is using the ASTM F138 Stainless Steel Bar as its material of production. Firstly the workers need to insert the stainless steel bar into the CNC Turning machine. Then the production process will begin with taper turning process. There are different types of cutters used in order to produce the body, the head of arrowhead and the tail of arrowheads. The turning process is done when the tail of arrowhead is parting by cutter MACR150R.

The semi-manufactured product is then sent to CNC Milling process. The main function of the CNC milling machine is used to shape, smoothen and flatten the head of arrowhead based on different dimension by using different cutter. The last process for ARROW-LOK Hybrid is inspection process. Profile projector has been used as the instrument to inspect the final product of ARROW-LOK Hybrid. The product will be packed in an unopened

packaging and sent for the shipping while the defective items will be destroyed.

In conclusion, throughout this project we had learned and discovered the function of utility of different types of CNC machines, the production process of the ARROW-LOK Hybrid and how the product is being manufactured. In addition, we had widen our view by studying more about the production of new innovative product like ARROW-LOK Hybrid. By estimation there are about 800 and 750 pieces of ARROW-LOK Hybrid can be produced by the CNC Turning machine and CNC Milling machines per day. This estimation has proved that the CNC machine can produce a product efficiently. Besides that, we also learn that the invention of ARROW-LOK Hybrid had brought some benefit for human being. The implantation of ARROW-LOK Hybrid in the operation procedure is easy to handle and the risk of side-effect that might occur onto patient had been minimize. It does definitely can be classified as a most genius device that lightens the patient life. However, there are many precautions need to be followed by the surgeon and patients in order to have a safe operation while using the ARROW-LOK Hybrid. Extra knowledge like direction of usage and storage condition have been discovered in our project too.

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